Australian Curriculum linked lessons

Statistics

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Students recognise and analyse data and draw inferences. They represent, summarise and interpret data and undertake purposeful investigations involving the collection and interpretation of data… They develop an increasingly sophisticated ability to critically evaluate chance and data concepts and make reasoned judgments and decisions, as well as building skills to critically evaluate statistical information and develop intuitions about data (ACARA, 2014, p. 3).

The challenge that faces primary teachers is how to begin to develop these 'big ideas' within the Australian Curriculum. In reading the documentation it is not always obvious how to go about this.

A good starting point is to consider the data collection and analysis cycle (Siemon, Beswick, Brady, Clark, Faragher & Warren, 2011) as illustrated in Figure 1.

In the early years much of the statistical work done centres around forming questions, collecting, organising and representing data, with the interpretation, analysis and forming of conclusions being done quite informally. Nevertheless, the cycle is a good model to have in mind when planning lessons.

Collecting and organising data

There are many ways to collect and organise data with young children. Initially, it is a great idea to represent the data with the children themselves as data points, then move on to representing the data with concrete materials such as unifix cubes, then to representations such as tables and graphs.

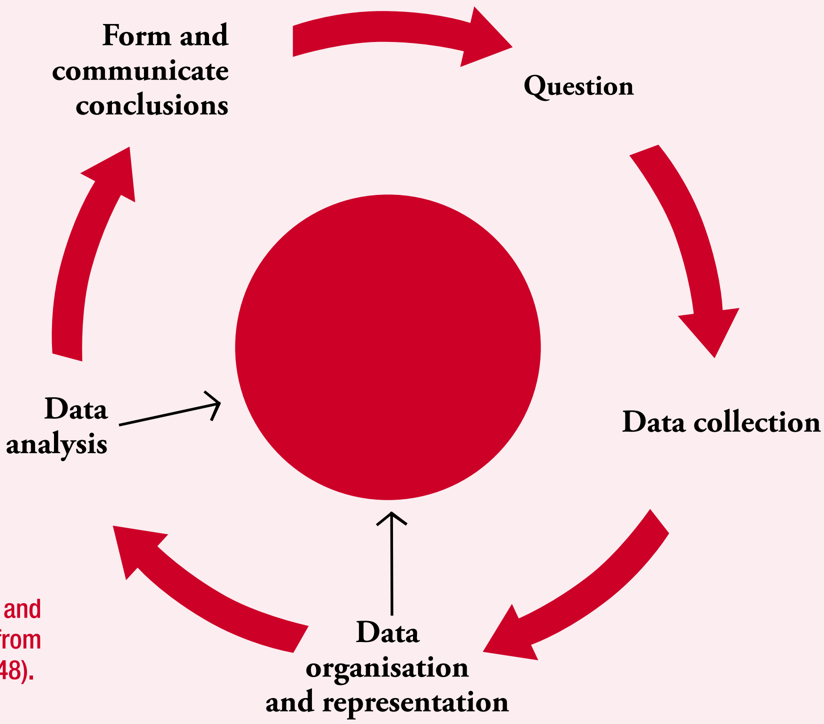

Figure 1. Data collection and analysis cycle (adapted from Siemon et al., 2011, p. 648).

Bouncing balls

This activity is adapted from Smith and Peterson (2006) and accesses several of the 'big ideas' in a very simple task. Students are asked first to estimate how many times they think they can bounce a ball in one minute. They conduct a 30 second experiment to see how valid their estimates are and modify them if necessary. Then they bounce a ball for one minute and write their total number of bounces on a sticky note. They record the class data on a line plot by placing their sticky note along a number line. This is an ideal activity to demonstrate that line plots are not always useful, especially when there is significant variation within the data. Having the data on sticky notes allows for the data to be easily re-positioned. By grouping the data (see Figure 2), a better idea of the shape of the distribution is evident. This can lead to the introduction and use of stem and leaf plots and measures of central tendency which provide a better view of the 'typical' score. Asking the question of what score the students would expect a new class member to have leads to the notion of using data to predict future outcomes.

Figure 2. Grouped data bouncing balls.

The outcomes associated with this lesson could include students: having an awareness that estimates can be based on initial trialling or sampling; recognising that data can be organised in different ways and that some ways are more effective than others; seeing that simple statistics can be used to summarise data; and that data can be used to make predictions.

Class pets

Sometimes we want to collect data about more than one category at once. I find magnetic strips a really good way to collect data about individual students, as, like the sticky notes, they are easy to re-position on a board. In this activity, students are asked to sort their data into different types of data representations, identify the similarities and differences of each, and decide which is the most useful and why.

I usually begin this activity (adapted from Smith and Peterson, 2006) outside on the netball court where two large circles have been created with ropes, using the students themselves as the data points. I begin with distinct data sets where students stand in the circles that represent how they got to school that morning, and then move to distinct yet overlapping categories, like cereal and/or toast for breakfast, so they can see what standing in the intersection of the two circles represents. Then I move the activity inside and draw two large overlapping circles on the board (see Figure 3). When students are challenged to place their name tag in the appropriate space on the board, much discussion ensues about what each 'space' means. Where do you place your name tag if you do not own any pets, for example? Together we compare the number of students in each part of the diagram and work out the differences. Quite often a student will mention that they do not have a cat or a dog, but they do have another pet. This leads to further discussion about how we could add another circle to the diagram and re-position our name tags.

I then draw up a two-way table and challenge students to place their name tag in the appropriate part of the table (see Figure 4). Students work out how many students are in each category and compare the categories by working out the differences. Some informal probability can be introduced here. A class discussion about the similarities and differences of the two ways of sorting and organising data, and which one they think shows the data more clearly and why, is always enlightening. As a result of this lesson, students should realise that data can be sorted and organised in different ways and that organised data allows us to answer some questions with numerical as well as descriptive answers. Students may be challenged to apply this idea of distinct yet overlapping categories to other questions of interest to them.

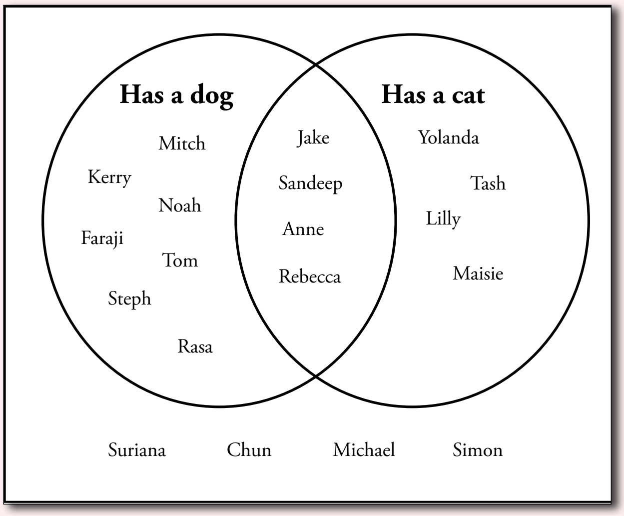

Figure 3. Venn diagram of pets.

	Has a dog	Does not have a dog	
Has a cat	Jake Sandeep Anne Rebecca	Yolanda Tash Lilly Maisie	8
Does not have a cat	Mitch Kerry Noah Steph Tom Faraji Rasa	Suriana Chun Michael Simon	11
	11	8	

Figure 4. Two-way table of pets.

Sampling, randomness and variation

What's in the bag?

This activity comes in many guises (e.g., Siemon et al., 2011; Williams & Lovitt, 2010), however they all address the big idea of sampling which replicates how samples are taken when it is not practical to collect data from an entire population. At an early age, the activity might be to place a small number of coloured cubes or unifix in a bag. Tell the students that you have five different coloured cubes in the bag. Have a student draw one cube out of the bag and record its colour. Ask the students what they now know about the cubes in the bag. Replace the cube and repeat the process of selecting a cube, recording its colour and asking the students what they now know about the contents of the bag.

Figure 5. 'What's in the bag?' sample.

Figure 6. 'What's in the bag?' answered.

Ask the students how many times they think they will need to draw out cubes to be sure about the contents of the bag. Many students will be surprised that it takes more than five trials to be certain about what is in the bag.

As students get more experienced at this type of sampling activity, the number of cubes may be increased and more than one of each colour can be included in the bag. For example you could have ten cubes in the bag using five colours.

One of my favourite activities is getting students to make up their own mystery bags and asking other students to predict what is in the bag after taking ten samples of one cube (see Figures 5 and 6).

This type of activity allows students to appreciate the natural variation that occurs in samples, the idea of randomness, and to appreciate what it means to sample in a statistical sense. A further extension would be to take samples that are larger than one, as is advocated in the What's in the Bag? maths300 lesson (Williams & Lovitt,

2010). Other activities such as Mystery Spinner (Downton, Knight, Clarke & Lewis, 2006) and Draw the Spinner (Erickson, 1989) use the same concepts, but do not have the advantage of replicating how samples are used in 'real life'.

How many fish are in the lake?

One of my favourite sampling activities is about modelling a scenario of catching and tagging fish to assist in knowing how many fish are in the lake. In order to do this, start with a large population (1000 to 1200 works well) of 'fish' in a container that is the lake. I find Beanz great for this activity. Get students to mix all the fish up to ensure that when a random sample is taken that every fish has an equally likely chance of being caught. Ask students to have a turn at 'fishing' (see Figure 7) until 100 fish have been caught.

Figure 7. 'How many fish in the lake?' simulation.

Once 100 fish have been caught, they are replaced with 100 fish that have been tagged (use different coloured fish as the tagged fish). Once the tagged fish have been released into the lake, the students should mix all the fish up again to ensure that each fish has the same chance as every other fish of being caught. Students who have not previously had the chance can then take turns at fishing, once again catching around 100 fish. The variation of how many tagged fish in each catch should be noted. The number of tagged fish in the sample can be used to predict how many fish live in the lake. For example: if there are nine tagged fish in the 100 fish caught then it would be reasonable to predict that approximately 9% of the fish in the lake were tagged, so the total population should be around 1100 fish. This activity brings together many of the 'big ideas' of statistics as described by Watson (2006) in a manner that should promote the proficiencies of understanding, problem solving, reasoning and fluency.

References

ACARA. (2014). *The Australian curriculum: Mathematics.* Retrieved from http://www.australiancurriculum.edu.au/mathematics/Curriculum/F-10?layout=1

Downton, A., Knight, R., Clarke, D. & Lewis, G. (2006). *Rich assessment for learning: Rich tasks and work samples.* Melbourne: Mathematics Teaching and Learning Centre, Australian Catholic University.

Erickson, T. (1989). *Get it together.* Berkeley, CA.: University of California.

Siemon, D., Beswick, K., Brady, K., Clark, J., Faragher, R. & Warren, E. (2011). *Teaching mathematics: Foundations to middle years.* South Melbourne: Oxford University Press.

Smith, R. & Peterson, S. (2006). *Maths in the making 1: Ages 6–8.* Carlton South: Curriculum Corporation.

Williams, D. & Lovitt, C. (2010). *maths300.* Education Services Australia. Retrieved from http://www.maths300.esa.edu.au/index.php?option=com_content&view=article&id=256